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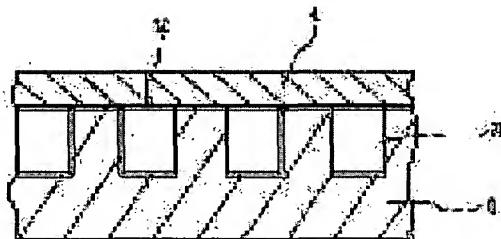
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## (54) METAL SEPARATOR FOR FUEL CELL

## (57)Abstract:

PROBLEM TO BE SOLVED: To provide a metal separator for a fuel cell, which has a low contact resistance, excellent water repellency, and good anti-corrosiveness.

SOLUTION: A fuel cell module is equipped with positive and a negative electrodes and electrolyte interposed between them, wherein a metal separator 1 is installed on each side of the module and is furnished with a groove 3 for gas flowing, and the surface of this groove at least is lined with a noble metal composite plating film consisting of entectoid of fluoro-resin or graphite fluoride particles. These separators 1 for fuel cell may be used in the same manner as a conventional separator, in particular favorably used in a fuel cell with a solid highpolymer electrolyte, and have low contact resistance, excellent water repellency at the groove 3, and good gas flowing possibility, and further an excellent anti-corrosiveness owing to the noble metal as matrix.



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CLAIMS

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[Claim(s)]

[Claim 1] the fuel cell in which it has been arranged at the both sides of the fuel cell module equipped with the electrolyte which intervened between the positive electrode, the negative electrode, and these positive/negative pole, and the slot of gas-stream popular use was formed — public funds — the fuel cell characterized by forming in the above-mentioned slot front face at least the noble-metals composite-coatings coat in which the fluororesin or the graphite fluoride particle carried out the eutectoid in a group separator — public funds — a group separator

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the metal separator used for a fuel cell, especially a solid-state macromolecule type fuel cell.

[0002]

[Description of the Prior Art] A fuel cell, for example, a solid-state macromolecule type fuel cell etc., arranges the metal separator with which the slot of gas-stream popular use was usually formed in the both sides of the module which made electrolytes, such as ion exchange membrane, intervene between positive/negative poles, and although it has the composition which installed two or more these, as this metal separator, the carbon board, gilding, the stainless steel board which carried out

platinum plating, etc. are used conventionally.

[0003] By the way, the property for which a metal separator is asked When it explains with reference to drawing 1 , contact resistance with the carbon paper 4 in the front face (contact section 2) of a separator 1 etc. is small, The passage (slot 3 formed in the separator 1) of gas is not blockaded with the water which hydrogen oxidized and was produced, but there is no disturbance by waterdrop, and circulation of gas is good, Not to corrode, even if it pours cooling water is demanded, and that corrosion resistance is still better, it being a low cost, a lightweight thing, etc. are required. If the moisture made on the boundary of an air pole and an electrolyte is not removed while water adheres and a gas passageway blockades if the contact resistance of a separator has the bad water repellence of making it as small as possible and a separator slot since useless voltage will be especially consumed if contact resistance is large, it is the portion into which this moisture interfered, and since the reaction of an air pole will not progress, water repellence is searched for.

[0004] however, since a carbon board is not excellent in conductivity and press working of sheet metal etc. could not do it easily, when a separator was formed with a carbon board, although cutting was carried out and the slot of gas-stream \*\* was attached, a weight is large, cutting expense is high, and it is cost quantity -- etc. -- there was a fault Moreover, the slot had the fault of that a conversion cost becomes high, a covering fluororesin tending to exfoliate, although fluororesin covering was carried out.

[0005] Possibility that a micropore may open for a material on the other hand since processability is not so good, although press working of sheet metal is possible for materials, such as SUS, gas leaks, and it becomes impossible to satisfy the performance as a separator of gas is also large. Then, when the slot was cut with etching, there was a problem of it having been heavy and becoming cost quantity.

[0006] Furthermore, there was a fault that above both of the water repellence of a slot were not good.

[0007] that by which this invention was made in view of the above-mentioned situation -- it is -- contact resistance -- low -- water repellence -- excelling -- a fuel cell with corrosion resistance good moreover -- public funds -- it aims at offering a group separator

[0008]

[A The means for solving a technical problem and the gestalt of implementation of invention] the fuel cell in which this invention has been arranged at the both sides of the fuel cell module equipped with the electrolyte which intervened between the

positive electrode, the negative electrode, and these positive/negative pole in order to attain the above-mentioned purpose, and the slot of gas-stream popular use was formed -- public funds -- the fuel cell characterized by forming in the above-mentioned slot front face at least the noble-metals composite-coatings coat in which the fluororesin or the graphite fluoride particle carried out the eutectoid in a group separator -- public funds -- a group separator is offered

[0009] In this case, although the above-mentioned noble-metals composite coatings may give noble-metals composite coatings to a slot and may give the usual gilding etc. to the contact section even if it gives them to the whole separator including a slot, it is desirable from a working plane, a cost side, etc. to give noble-metals composite coatings to the whole separator.

[0010] There is no un-[ which the top where contact resistance is small, and water repellence are high since, as for the separator of this invention, the compounded distribution, eutectoid, and noble-metals composite-coatings coat is uniformly formed for the fluororesin or graphite fluoride particle into the noble-metals matrix, such as Pt, Au, Pd, and Ag., the water repellence of a slot is good, moisture removal is made easily, and water adheres / un-/ to a slot, and makes a gas passageway blockade ] arranging, and the distributivity of gas is Moreover, corrosion resistance is also excellent.

[0011] Hereafter, lessons is taken from this invention and it explains in more detail.

[0012] As for the metal separator for fuel cells of this invention, an eutectoid and the distributed noble-metals composite-coatings coat are formed in a gas-stream popular use slot front face for a fluororesin or a graphite fluoride particle into a noble-metals matrix at least.

[0013] lightweight, although a well-known thing is conventionally used as this separator material, for example, aluminum, a stainless steel, titanium, etc. can be used here -- etc. -- it is desirable that it is made from an aluminum plate at a point

[0014] When giving noble-metals composite coatings to such a metal material, after removing an oxide film using an acid to well-known pretreatment according to the kind of the material, for example, an aluminum material, in the case of zinc substitution processing, a stainless steel, or titanium, strike nickel-plating processing using wood nickel-plating liquid is performed.

[0015] In this case, when a ground plating coat can be formed after such pretreatment and zinc substitution processing especially of the aluminum is carried out, it is desirable to perform noble-metals composite coatings through a ground plating coat. As this ground plating coat, nickel-alloy plating coats, such as a nickel or nickel-Lynn

alloy, can be formed, and a ground plating film with a thickness of about 1-50 micrometers can be formed by well-known electric nickel plating or the non-electrolyzed nickel-plating method.

[0016] Noble-metals composite coatings can be performed using the composite-coatings liquid which distributed the eutectoid particle (water-repellent particle) which becomes the well-known electric noble-metals plating liquid containing the water-soluble salt of noble metals, such as Pt, Au, Pd, and Ag, from a fluororesin or a graphite fluoride particle.

[0017] Here, specifically, the detailed powder (about 0.1 – about 3-micrometer particle size) of fluorine-ized resins, such as graphite fluoride, PTFE (polytetrafluoroethylene), FEP (full ORONEI Ted ethylene propylene) and PFA (a tetrafluoroethylene / perfluoroalkyl vinyl ether copolymer), ETFE (ethylene / tetrafluoroethylene copolymer), PVDF (poly vinylidene fluoride), and ECTFE (ethylene / chlorotrifluoroethylene copolymer), can use it suitably as an eutectoid particle.

[0018] Since it is hard to get wet in water, as for these, it is good to use a well-known surfactant and to make it distribute by the well-known method. For distribution and an eutectoid, a cationic surface active agent can use it suitably. What has the thing and perfluoroalkyl machine which have a long-chain hydrocarbon group as a hydrophobic group as a cationic surface active agent can be used. For example, they are a dodecyltrimethylammonium bromide, dodecylbenzyl dimethylammonium chloride, perfluoroalkyl trimethylammonium bromide, etc.

[0019] In addition, the amount of these eutectoids particle used is selected suitably, and is added in an amount from which the amount of composites (the amount of eutectoids) mentioned later is obtained.

[0020] It is desirable for performing composite coatings using the above-mentioned noble-metals composite-coatings liquid to face and to use convenient liquid churning and a liquid cyclic process for distributing the particulate material which carries out an eutectoid. If plating liquid is put, since it will precipitate downward or it will float upwards, it is good to carry out liquid circulation loosely.

[0021] Plating appearance will tend to become uniform if a plating article is rocked. in addition, the plating liquid (matrix plating liquid) with which plating conditions, such as solution temperature, pH, and current density, do not contain an eutectoid particle -- being the same .

[0022] in the above-mentioned eutectoid particle, distribution and uniformly although [ coat / plating / which is obtained using such noble-metals composite-coatings liquid / inside / of a noble-metals matrix ] it comes to carry out an eutectoid, the amount of

composites to the inside of the plating coat of an eutectoid particle (the amount of eutectoids) is about two to 30 vol% -- desirable -- especially -- about 10 -- water repellence is high in it being the amount of composites beyond vol% Moreover, although the eutectoid particle is carrying out the outcrop to the front face, if a part of fluororesin which heated and carried out the eutectoid of the plating coat is fused, water repellence of this plating coat will improve further.

[0023] Moreover, when the eutectoid of the fluororesin is carried out and the contact angle with the water of the above-mentioned plating coat carries out the eutectoid of about 110-60 degrees and the graphite fluoride particle, it is about 150-110 degrees.

[0024] In addition, although the thickness of the above-mentioned plating coat is also selected suitably, 0.2-20 micrometers is 1-15 micrometers especially.

[0025] In this invention, although [ of the above-mentioned separator ] the above-mentioned noble-metals composite-coatings coat is formed in a slot at least, this plating coat can be formed in both a slot and the contact section in this case, since matrices are noble metals, although this composite-coatings coat has low contact resistance, it can perform noble-metals plating which performs the above-mentioned composite coatings to a slot as occasion demands, and does not contain an eutectoid particle in the contact section, and a noble-metals plating coat can be formed. For example, Pt/PTFE composite coatings may be performed to a slot and you may plate with gold separately at the contact section. However, it is desirable to exfoliate, after appending and carrying out the mask of the resist in this case, for it to be necessary to exfoliate, after appending and galvanizing a resist in another place further, and for time and an effort to be applied, and for there to be a possibility of becoming a cost rise, therefore to galvanize a slot and the contact section simultaneously.

[0026]

[Effect of the Invention] The metal separator for fuel cells of this invention can be conventionally used in the same mode as a well-known separator, and although it is suitable as a separator of a solid-state polyelectrolyte type fuel cell, contact resistance is low, and the separator of this invention excels [ contact resistance ] in the water repellence of a slot, a good gas-stream denominator is secured, and since matrices are moreover noble metals, it is especially excellent [ separator ] also in corrosion resistance.

[0027]

[Example] Although an example is shown and this invention is explained concretely hereafter, this invention is not restricted to the following example.

[0028] After performing pretreatment (zinc substitution processing and AZ process made from Kamimura Industry are used) which shows the gas circulation fluting separator made from aluminum of 200x184mm of \*\* outside [an example 1] below according to a conventional method, the 20-micrometer nickel-plating coat was formed using the electric nickel-plating liquid of the following composition, on it, the electric platinum composite-coatings liquid of the following composition was used, and the 0.5-micrometer compound platinum plating coat was formed.

Pretreatment alkali cleaner U-cleaner UA-68 (50 g/L, 50 degrees C, 5 minutes)

\*\* backwashing-by-water alkaline etching agent AZ-102 (50 g/L, 60 degrees C, 30 seconds)

\*\* backwashing-by-water JISUMATTO JISUMATTA AZ-201(200 g/L)+ nitric acid (800mL /L) (a room temperature, 30 seconds)

\*\* backwashing-by-water zinc substitution AZ-301 (a room temperature, 1 minute)

Are \*\* backwashing-by-water nitric-acid immersed. Nitric-acid 800 mL/L (a room temperature, 30 seconds)

\*\* backwashing-by-water zinc substitution AZ-301 (a room temperature, 1 minute)

Electric nickel-plating liquid and plating conditions Nickel sulfate 285 g/L Nickel chloride 45 g/L Boric acid 40 g/L pH 4.2 Solution temperature 55 degrees C is agitated. Compressed air agitation Cathode current density 5 A/dm<sup>2</sup> Plating time The electrical-and-electric-equipment platinum composite-coatings liquid during 22 minutes, and plating conditions As H<sub>2</sub>Pt(NO<sub>2</sub>)<sub>2</sub>SO<sub>4</sub>Pt, 5 g/LPTFE 20g/L Dodecyl trimethylammonium chloride 2 g/L It is referred to as pH 2 with a sulfuric acid. 40 degrees C of solution temperature Cathode current density 0.5 A/dm<sup>2</sup> Anode plate Pt Plating time For 4 minutes Churning Liquid churning by pump circulation [0029] As for the obtained platinum composite-coatings coat, PTFE (polytetrafluoroethylene) of the amount of eutectoids of PTFE was [ the eutectoid and ] 15vol(s)% dispersedly uniformly in platinum.

[0030] The carbon board was put on this galvanized separator, it pressed by planar pressure 5 kgf/cm<sup>2</sup>, and contact resistance with the carbon board of this separator was measured. Consequently, all resistance was the 5-20m ohm<sup>x</sup>cm<sup>2</sup>, and was good. Furthermore, although the contact resistance after \*\*(ing) for 100 days to the air containing a 75-degree C saturated steam as a corrosive environment was measured, increase of contact resistance was less than 5%.

[0031] Next, ion exchange membrane was made into the polyelectrolyte for the above-mentioned separator a 16-sheet pile and between them, the fuel cell which infixes the module which allotted the well-known oxygen electrode and the hydrogen

electrode to the both sides was created, and the power generation examination of 100 hours was performed. As a result of measuring the contact resistance of the above-mentioned separator after a power generation examination, increase of contact resistance is less than 10%, and it became clear that there is almost no degradation in a separator.

[0032] Moreover, most degradation was not accepted but, as for the above-mentioned fuel cell, that the utilization factor of hydrogen and oxygen gas hardly falls made 100 hours after clear.

[0033] Furthermore, as a result of measuring the contact angle of the above-mentioned separator (platinum composite-coatings coat) and water before and after a power generation examination, the contact angle was 90–100 degrees, and water repellence was very good.

[0034] The separator was obtained like the example 1 except having used the electric silver composite-coatings liquid of the following composition, and having formed the 10-micrometer silver composite-coatings coat instead of the platinum composite coatings of the [example 2] example 1.

Electric silver composite-coatings liquid and plating conditions KAg2 (CN) They are 20g/L as Ag, KCN (free) 15 g/L Potassium carbonate 15 g/L PTFE 30 g/L Dodecylbenzyl dimethylammonium chloride 3 g/L Solution temperature 25 degrees C Cathode current density 1 A/dm<sup>2</sup> Churning Liquid churning by pump circulation

[0035] the obtained silver composite-coatings coat — PTFE — 20vol(s)% — the result which is carrying out the eutectoid, assembled the same fuel cell as an example 1, and performed the same examination was the same as that of an example 1

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[Translation done.]